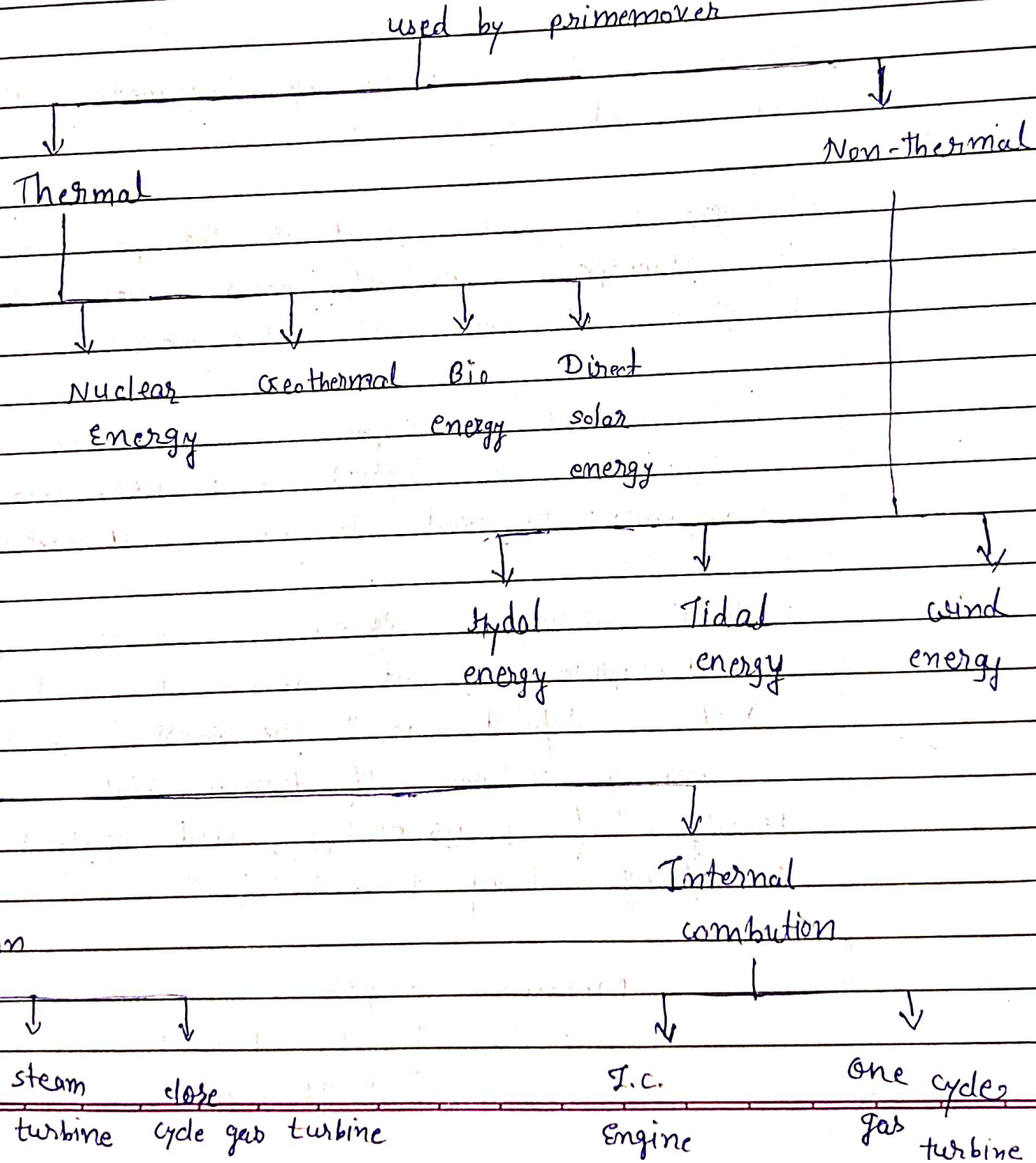
1 What is prime mover? Give types of prime movers on basis of resources utilized.

⇒ Prime mover:- A prime mover is defined as a def device which converts energy from natural sources into mechanical energy or useful work (shaft power). Examples of prime movers are:-
1) wind turbine 2) steam turbine and 3) water turbine etc.



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2 Define pressure, standard ↓ pressure and atmospheric absolute pressure, vacum and draw schematic diagram showing relation between diff. pressures.

⟹

Pressure :- It is the force exerted by fluid (liquid or gas) on unit area. It is a property of fluid.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} \quad \text{or} \quad = \frac{N}{m^2} \text{ or Pascal}$$

→ Pressure is measured by Barometer, Pressure gauges and manometers.

Atmospheric Pressure :- It is the pressure exerted by atmosphere. The atm pressure varies from place to place. At sea level the pressure is...

1 standard atmosphere (atm) = 101325 Pa
= 1.01325 bar

→ Barometer is used to measure atmospheric pressu

Standard atmospheric Pressure :- It is a pressure of atmospheric air at mean sea level.
→ It is defined as " The pressure produced by a mercury column of 760mm high having a density of 13595.09 kg/m³ and accelaration due to gravity being 9.80665 m/s². "

Now,

$$\text{pressure} = \rho \times g \times h$$
$$= 13,595.09 \times 9.80665 \times 760 \times 10^{-3}$$
$$= 1.01325 \text{ bar}$$

Absolute pressure :-

It is the pressure measured with refrence to absolute zero pressure. It is the pressure related to perfect vaccum.

→ Mathomatically, Absolute pressure = Atmospheric pressure + Gauge pressure

Vaccum :-

The pressure ~~below~~ below atmospheric ~~pressure~~ pressure is called vacuum. A perfect vacuume is obtained when ~~Absolute~~ absolute pressure is zero. at this instant molecular moment is zero. ~~The relation~~

3 Define high and low grade energy and also give two examples of each.

⇒ Low grade energy :- Only a certain portion of energy that can be converted into mechanical work (shaft power), that energy is called low grade energy.

Examples :- Thermal or heat energy, Heat derived, Heat of nuclear fission

High grade energy :- Energy that can be completely converted (neglecting loss) into work.

Examples :- Mechanical work, electrical energy, water power, wind and tidal power, kinetic ~~power~~ energy of jet.

4 State similarities and dissimilarities of work and heat.

⇒

1) All kind of energy interaction in thermodynamics are work interaction. while for heat interection there should be tempreture difference between the system and surrounding.
2) Work and heat both path dependent, they do not depend upon the end state of the system.
3) Both are boundary phenomena. Both can only observe at system boundry.
4) Heat is low grade energy while work is high grade energy.
5) Heat is treated as disordered kind of energy while work is ordered kind of energy.
6) Heat in flow or flow out include entropy but there is no entropy in work.
7) Efficiency of converting heat to work is less but viseversa is high.

5 Define path, process and cycle and explain them with suitable sketch.

⇒ Path is the series of states passed through the system during change of equilibrium from one to another.

→ when path followed by system during change in one equilibrium state to another is called process.

→ Thermodynamic cycle is a process in which initial & final conditions are same.

→ here a, b, c, d are state.
→ line joining a, b, c, d are path.
→ complete path through 1 to 2 is a process.
→ Process 1 to 2 & 2 to 1 is a cycle because initial & final both state is 1.

6) Define
specific heat : It is defined as heat required to raise the temprature of unit mass by one degree.
unit → kJ/kg·K

Internal energy : Internal energy is a type of energy which is neither heat nor work, hence it is stored in form of energy
→ denoted by 'U'.

Enthalpy :- Enthalpy is thermodynamic property of fluid.
→ It is summation of internal energy & product of its pressure & volume.

$$H = U + PV$$

Brake power :- Power obtained at engine flywheel & measured by dynamometer is called Brake power.
→ measured in kW.

Indicated Power :- The power produced in cylinder of engine as a result of combution of fuel is called Indicated power.

Frictional Power :- The difference between break power & Indicated power is called frictional power.

7) State zeroth & first law of thermodynamics and explain these law with suitable examples.

⇒ Zeroth law of thermodynamics :-
Zeroth law of body thermodynamics stats that "the bodies A and B are in thermal equilibrium with a third body seprately then the two bodies A and B shall also be in thermal equilibrium with each other.".

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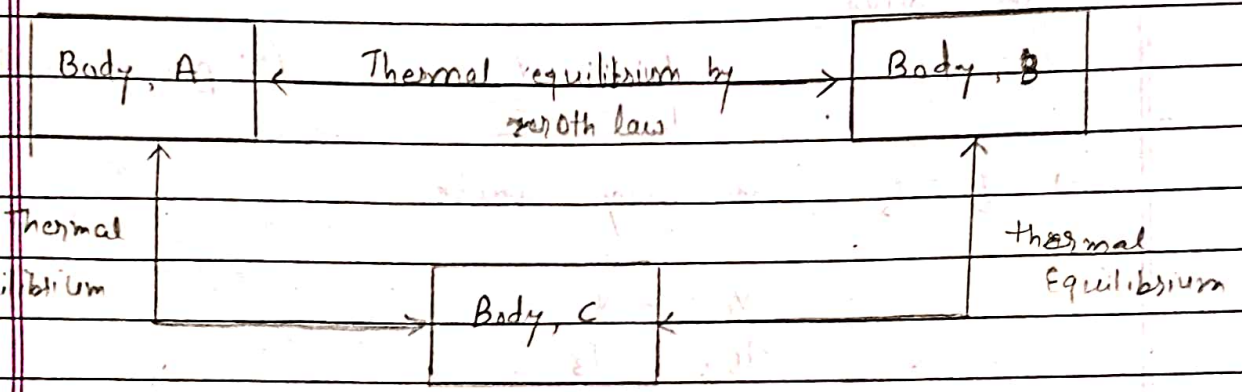
Example → when we put ice into a glass and after this put this system into surrounding then glass and ice are into thermal equilibrium, after some time later ice will be melt and they all are in thermal equilibrium with surrounding.



First law of thermal equilibrium :-

The first law of thermodynamics is the law of conservation of energy and it states that "energy can neither be created nor destroyed, it can be converted from one form to another and total energy remains same."

change in total energy = net energy transffered as heat and work.

$$\Delta E = Q - W$$

$$\therefore \Delta E = Q - W = \Delta U + \Delta KE + \Delta PE$$

$$\therefore \Delta U = Q - W$$

→ for $\Delta E = 0$, cycle process...

$$Q - W = 0$$

→ the net heat transfer and net work done during a cycle process are equal.

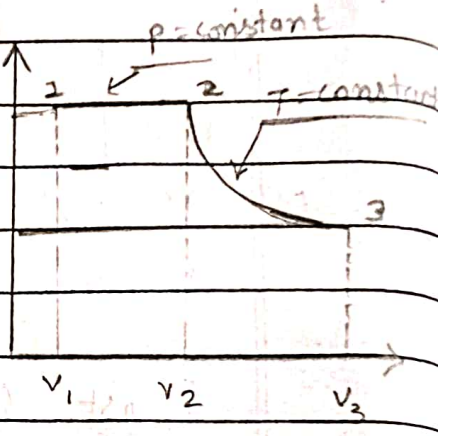
Example :- Photosynthesis which converts the solare energy into chemical energy.

8 Derive the equation for combine gas law.

⇒

Applying charles law we have,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad (\because p \text{ constant})$$



→ $T_2 = T_3$, we may write, $P_1 = P_2$

$$\frac{V_1}{T_1} = \frac{V_2}{T_3}$$

→ for process 2-3,

$P_2 V_2 = P_3 V_3$, since $P_2 = P_1$

$\therefore P_1 V_2 = P_3 V_3$

$\therefore V_2 = \frac{P_3 V_3}{P_1}$

$\therefore \frac{V_1}{T_1} = \frac{P_3 V_3}{P_1 T_3}$

$\therefore \frac{P_1 V_1}{T_1} = \frac{P_3 V_3}{T_3}$

$\therefore \frac{PV}{T} = \text{constant}$

→ $\frac{pV}{T} = mR$

$\therefore \boxed{pV = mRT}$ eqⁿ of state for perfect gas

9 Prove that $C_p - C_v = R$

⇒ → let m kg mass heated at constant volume from temprature T_1 to T_2.

→ Heat supplied at constant volume...

$Q_v = m C_v (T_2 - T_1)$

$= \Delta U$

→ when heated at constant pressure

$\therefore Q_p = m C_p (T_2 - T_1)$

→ This heat serves two purposes:-

* increase of internal energy $= m \times C_v (T_2 - T_1)$
* work transfer/work done $= \boxed{\Delta U}$

$\Downarrow p(V_2 - V_1) = \boxed{W}$

$\therefore m C_p (T_2 - T_1) = m C_v (T_2 - T_1) + p(V_2 - V_1)$

→ using ideal gas relationship..

$pV = nRT$

$\therefore C_p - C_v = R$

10 Explain the formation of steam at constant pressure with suitable sketch.

⟹ The graphical representation of 1 kg of ice into 1 kg of superheated steam at constant pressure is known as t-h diagram shows the various (temp. Vs enthalpy) stages of formation of steam starting from ice shows corresponding t-h diagram.

11 Explain different stages of steam.

⇒ 1) Wet steam :-

→ A wet steam is a ~~two~~ two-phase mixture of entrained water molecules and steam in thermal equilibrium at the saturation temperature corresponding to a given pressure.

2) Dry saturated steam :-

→ A steam at the saturation temperature corresp-onding to a given pressure and have no water molecules entrained in it is known as dry saturated steam or dry steam. Its dryness fraction will be unity.

3) Superheated steam :-

→ When dry saturated steam is heated further at given constant pressure, its temprature rises beyond its saturation ~~pressure~~ temp. The steam in this state is said to be superheated.

12 Define the following terms.

1) saturation temprature :- The ~~temprature~~ for a corresponding ~~pressure~~ saturation pressure at which a liquid boils into its vapour phase.

2) Latent heat of vaporization :- The quantity of heat in joules required to convert 1 kg of liquid to vapour or gas, without any change in temprature.

3) sensiable heat :- The sensiable heat is energy required to change the temprature of a substance with no phase change.

4) Amount of superheat :- The difference between actual tempreture of body and saturation temprature.

5) Degree of superheat :- The difference between a superheated vapour and saturated vapour at same pressure is called degree of superheat.

6) Dryness fraction :- Dryness fraction is defined as the ratio of the mass of dry vapour to combined mass of dry vapour and mass of liquid in the mixture.

13) What is difference between dry saturated steam and wet steam ?

⇒

Dry saturated steam	Wet steam
A steam at saturation temprature corresponding to a given pressure and having no water molecules etrained is known as dry steam which dryness fraction will be unity.	A steam which is two-phase mixture of etrained water molecules at thermal equilibrium. and steam in it and at saturated temp corresponding to a given pressure.

14) Why steam is superheated & give pros and cons of superheated steam.

⇒ When a dry steam is heated further at the given constant pressure, its temperature rises beyond its saturation temperature. The steam in this state is called superheated.

→ The pros are :- It prevents oxidation of heated items and lowers the possibility of fires or explosions.

→ The cons are :- It has lower heat transfer rates, variable temprature at constant pressure, larger surface area required.

15) Define Boiler. List essential parts of boiler.

⇒ Steam boiler is a closed vessel in which heat is produced by combustion of fuel which is utilized to generate steam from water, at desired temprature and pressure.

1) Burners : (where air mixes with fuel source and combusts)
2) Combustion chamber.
3) Heat exchanger
4) supply lines and return lines
5) superheater
6) circulator pump.

16) What is difference between boiler and steam generator.

⇒ * steam Boiler :-

water convert into steam by boiling at sub-critical pressures, the steam generating equiptment system is called steam boiler.

steam generator :-

water convert into steam without boiling at sub-critical pressures, the steam-generating equiptment system is called steam generator.

→ It is better than steam boiler.

17) Give classification of boiler.

⇒ 1) According to geometric orientation of boiler.
2) According to position of water & hot gases.
3) According to location of furnance.
4) According to method of water circulation.
5) According to working pressure.
6) According to mobility of ~~water~~ boiler.
7) According to number of tubes in boiler.

18) State merits and demerits of water tube boiler over ~~and~~ fire tube boiler.

⇒ 1) water tube boilers are high-pressure boilers and operating pressure is about 250 bar when fire tube boilers are low-pressure boilers and operating pressure is about 25 bar.

2) In water tube boiler the rate of steam generation and ~~quantity~~ quality of steam is better and suitable ~~for~~ and power generation whether in fire tube boiler the rate of steam of generation and quality of steam is very low, so not suitable for high power generation.

3) Water tube boiler requires less floor area whereas fire tube boiler requires more ~~or~~ floor area.

4) In water tube boiler oversall efficiency is ~~about~~ upto 90%. whether in fire tube efficiency is about 45%.

5) In water tube boiler water circulates in well defined direction rather than fire tube boiler.

19) Explain the working of Cochran boiler with neat sketch.

⇒ → ~~The~~ working of ~~coh~~ cochran boiler :-

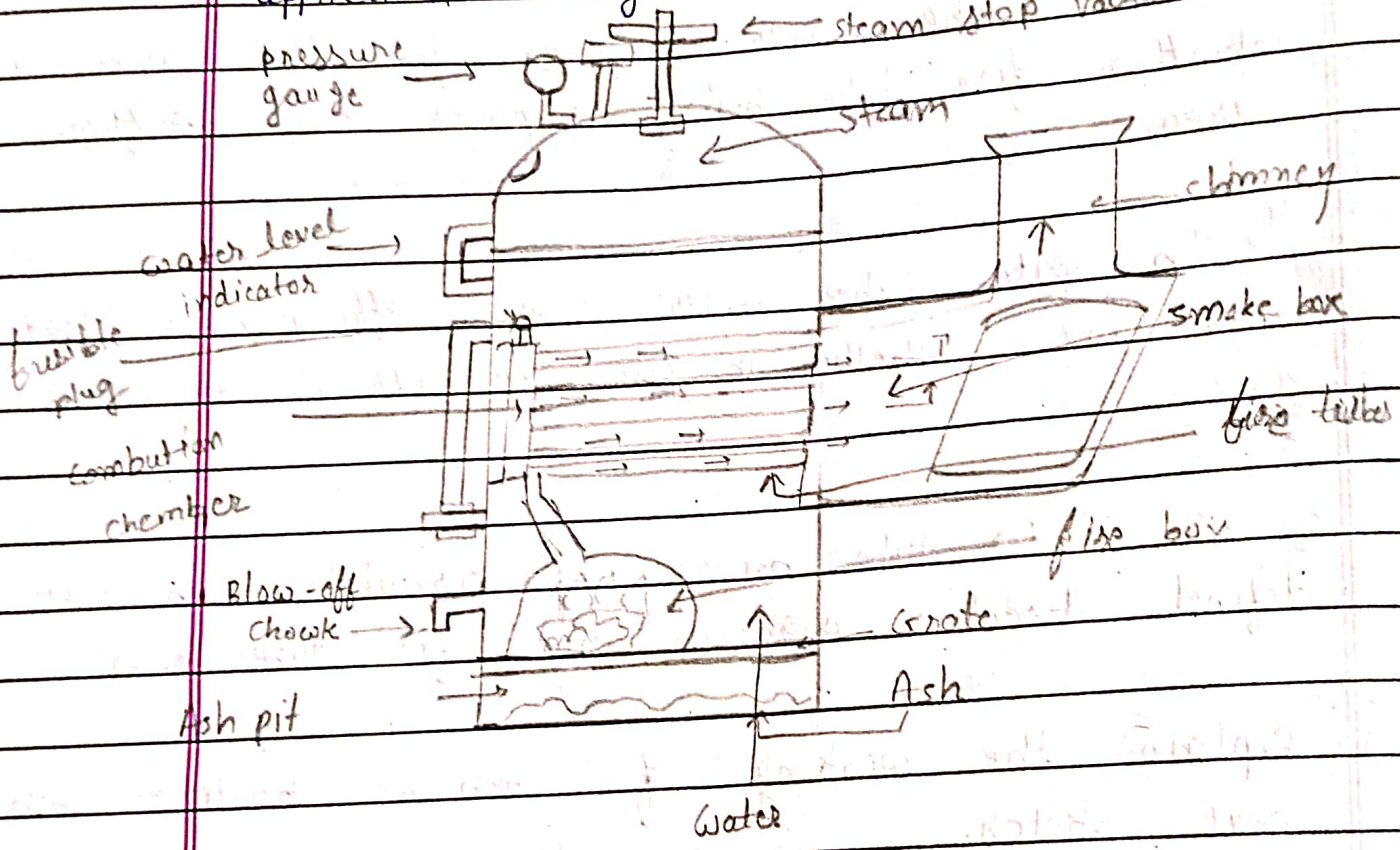
→ The water feed inside the Cochran boiler through the feed check and level of water is checked by water level indicator.

→ The fuel is supplied inside the furnance over the great through fire hole.

→ The hot gases are produced by burning of fuel come to combution chamber through the fuel pipe.

→ These hot gases from the combution chember passes through the fire tubes and come to smoke box and release to envisonment through chimney.

→ When the hot gases ~~are~~ passes through the fire tubes the heat is transffered to water and upper layer of water gets converted into the steam collect in the upper dome of the boiler.
→ The collected steam utilize for different application through steam stop value.



20) How natural circulation is achieved in boiler?
⇒ water flow takes place naturally by density difference of water.
Ex. Babcock.

21) state applications of steam boiler.
⇒ 1) water heating
2) Sanitation
3) cooking
4) waste energy utilization.
5) central heating.

22) write following functions of following terms in boiler.

1) steam stop value :-
It usually com: connected directly to the boiler for purpose of shutting off the steam from main steam line.

2) Blow off cock :-
It helps to drain out the water periodically from boiler.

3) fusiable plug :- It reduces the risk of boiler explosion.
→ It operates as safty valve.

4) pressure gauge :- It is usually front in boiler, which indicates the pressure of water levelling in boiler.

5) water level indicator :- It helps to indicate level of water in boiler.

23) Enlist various boiler mounting & accessories.
⇒ Boiler mounting for safety :
1) Water level indicator.
2) safty valve
3) fusible plug.

Boiler monting for control :
1) pressure gauge
2) stop valve
3) feed check valve
4) Blow-off valve.

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Boiler Accessories :-

1) water Heating device
2) water feeding device
3) superheaters
4) Air preheater.